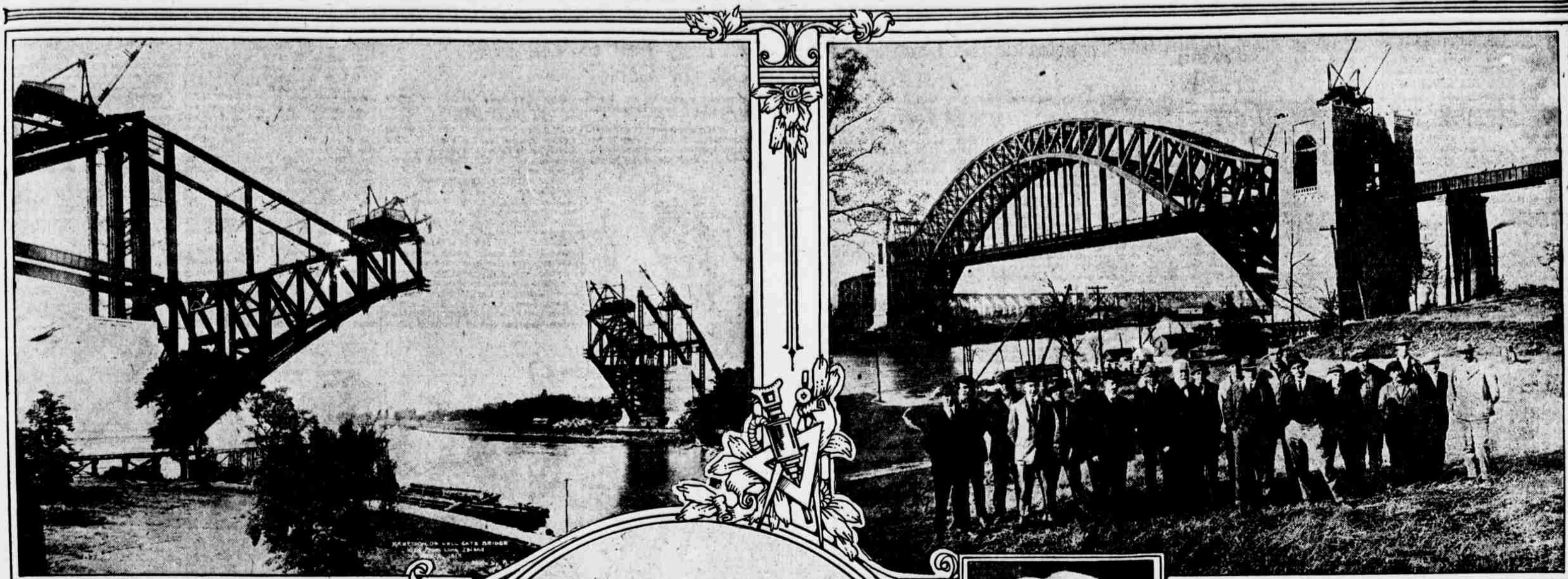


WORLD'S HEAVIEST BRIDGE NOW SPANS HELL GATE'S TIDES



HOW THE HALF SECTIONS OF THE ARCH REACHED OUT FROM EITHER SIDE OF THE RIVER WHILE BEING HELD ALOFT BY THE GREAT BACKSTAYS OF THE TEMPORARY CANTILEVERS.

An Engineering Feat Called Great Even in This Day of Wonder Workers in Steel

THE WORLD'S GREATEST STEEL ARCH BRIDGES.

	Span.
Hell Gate.....	1,017 feet
Clifton arch, Niagara Falls.....	840 feet
Vlaar Viaduct, France.....	721 feet
Rhine bridge, Bonn.....	614 feet

THE steel arch across Hell Gate, the heaviest bridge in existence, will soon be ready for traffic, and it will then be possible for travelers to pass through New York, going north or south, without any of the inconveniences and delays that have hitherto been unavoidable. Time will be saved, money will be saved.

The Hell Gate bridge is part of a ten mile project known as the New York Connecting Railway, and of this, the East River division alone represents an outlay of \$30,000,000 and covers a stretch of three and a half miles. The massive span has cost \$12,000,000. It is an interesting illustration of what up to date American railroads are willing to spend in order to please their patrons and to shorten runs. The East River is a much bridged waterway, but from an engineering standpoint none of the other bridges is to be compared with the newest span.

The entire project was conceived more than ten years ago when railroad men turned their minds to the problem of speeding passenger traffic through New York city and of hastening freight through or around the metropolis without increasing the congestion existing even then. To help them to a solution, they called to their aid the best engineering talent. The outcome of the combined studies of the experts was a route that would allow passenger traffic to and from New England to pass through the Pennsylvania terminal on Manhattan, using both the Hudson and the East River tubes, while freight trains would use the Borough of Queens and Brooklyn to the Bay Ridge shore, where they would be ferried across the bay to the Greenville pier. The whole line was fairly plain sailing with the exception of one staggering obstacle, Hell Gate.

The character of that waterway of-

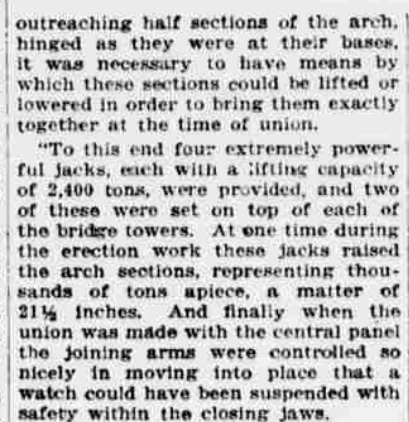
fered natural difficulties enough, and these were augmented by the volume of traffic threading that tortuous, turbulent route. It was impossible to build false works which might interfere with shipping, and to be profitable it was necessary that the bridge should be wide enough and strong enough to carry four tracks and to bear the burden of heavily laden trains. Here was an economic prerequisite that was enough to balk the best engineering cunning, and yet if the project was to pay a bridge of that capacity had to be provided.

Could it be done? There was nothing in the way of a precedent to answer the question. The whole scheme hinged upon the building of this particular link, and that seemed to most people quite impracticable. Not, however, to Gustav Lindenthal, the engineer. How well he planned and how well the workers wrought is evidenced to-day.

Mr. Lindenthal has a modest way of speaking of this latest monument to his technical skill. "To an engineer one bridge differs from another only in magnitude," he said, "much as one egg is bigger than another egg. All such structures have basic principles that persist no matter what may be their proportions."

"The Hell Gate bridge is mainly different from other steel arches because of its length and its exceptional weight. These features imposed certain mechanical problems that had to be met, and to do so successfully it was necessary to devise special apparatus and facilities."

"To begin with there were reasons why an arch should be adopted instead of a cantilever span, the ends of the arch to be supported by flanking towers of masonry and there hinged so that the half sections could be brought together finally at the center with the nicest sort of precision far above the unobstructed river. To control the growing weight of the



LEVELING UP ONE OF THE GREAT HYDRAULIC JACKS PLACED ON TOP OF ONE OF THE TOWERS.

outreaching half sections of the arch, hinged as they were at their bases, it was necessary to have means by which these sections could be lifted or lowered in order to bring them exactly together at the time of union.

"To this end four extremely powerful jacks, each with a lifting capacity of 2,400 tons, were provided, and two of these were set on top of each of the bridge towers. At one time during the erection work these jacks raised the arch sections, representing thousands of tons apiece, a matter of 3 1/2 inches. And finally when the union was made with the central panel the joining arms were controlled so nicely in moving into place that a watch could have been suspended with safety within the closing jaws.

"From start to finish the building of the bridge was carried along without a single mechanical breakdown of any importance. The rivets used in the span are the biggest and longest ever employed, and their driving called for the use of the largest of pneumatic hammers. These tools

were, of course, difficult to handle in the beginning, and it took some time to train the riveters to control them properly. They acquired the trick after a while, and it was not until the men were thoroughly proficient that they were allowed on the actual job.

"Some of the other special facilities were equally out of the ordinary run, and time and practice were necessary in order to make their management or manipulation accurate. Remember, while the heaviest sections of some other bridges are as ponderous as the heaviest used on the Hell Gate span, no other bridge in its entirety is so massive; and all of the great weights had to be hoisted into place and secured with the utmost precision.

"At the center, the top of the arch is 305 feet above mean low water, and the closing panel weighed 300 tons. The lifting machinery was therefore of unusual capacity, and notwithstanding the extraordinary loads every part was raised and moved into position to a nicety."

Mr. Lindenthal's brief explanation

quite fails to tell anything but a small part of the story of this engineering accomplishment. The undertaking has been followed with interest by the whole engineering world, and there were some critics who persisted until the final union was made in believing that something would fail and millions of dollars be sacrificed in a disastrous crash. They had in mind the collapse of the first Quebec bridge, and their fears were somewhat justified when the second Quebec span gave way as the central panel was being hoisted into position.

The secret of Mr. Lindenthal's success has laid in his capacity for infinite pains in preparation. No detail has been too small to warrant his personal attention. No wonder, then, that his plans, when exhibited at Leipzig two years ago, won for him the highest award and a gold medal.

To-day the Hell Gate bridge represents a sustained mass of 19,000 tons of steel alone. From pier to pier the arch spans an interval of 1,017 feet. This far exceeds the reach of any



GUSTAV LINDENTHAL ENGINEER

THE FINISHED BRIDGE OVER HELL GATE. GUSTAV LINDENTHAL AND THE MEN THAT HELPED IN THE BUILDING OF THE BRIDGE

Link in Transportation Chain That Will Help Lessen Freight Congestion in New York

taken across the gap before the central panel was linked up showed agreement within five-sixteenths of an inch with the lengths previously calculated. Here even the climax of two years of abstruse computation and many months of building together of 40,000,000 pounds of steel. The layman will more fully grasp this engineering marvel when he bears in mind that the bridge and its temporary cantilever structure utilized thousands and thousands of pieces of steel of varying lengths and thicknesses, and only by fitting these together with the greatest nicety was it possible to obtain this degree of accord. Further, there was the question of expansion and contraction not only as the general temperature changed but as the heat of the summer sun affected unequally different parts of the growing arch and the backstays.

Mr. Lindenthal foresaw all these difficulties and anticipated them by providing the four enormous hydraulic jacks already mentioned. These jacks, especially built for the work, made it possible to take care of any temporary sagging in the half sections of the arch held aloft by the tension of the cantilever backstays. They were able to raise the saddles of the cantilevers when they passed over the tops of the towers.

In this way the cantilevers were raised fifteen inches above their final positions, lifting at the same time the unjoined tips of the arch sections, though of course not to the same extent. Finally by lowering the four jacks the two cantilevers were brought together, the loads on the backstays were released and the arch so joined became a self-supporting structure. Again, as further proof of the astonishing accuracy of the engineers, the final lowering of the arch halves was within one-thirty-second of an inch of the distance previously estimated.

Since October 1, 1915, the trackway suspended from the arch has been built, and to-day the bridge is ready to bear the live load of twelve tons per linear foot, while sustaining twenty-six tons of structure per linear foot. For the sake of normal comparison this live load might be likened to the weight of forty-five of the biggest and heaviest of modern locomotives in motion.

Traffic experts estimate that something like forty fast through passenger trains will traverse the Hell Gate route daily, and travelers from Boston bound to the West and South may make their journey without transfer when reaching Manhattan. Apart from the matter of convenience a great deal of time will be saved. Where freight is concerned, the line as to permit navigation by large vessels, it was necessary to provide a lift bridge. It is of the bascule type and consists of two spans each 175 feet long. In sinking the foundations for the piers of this structure uncertain ground was struck, and the engineers finally had to go down well over a hundred feet before reaching solid rock.

While the Hell Gate arch was joined on October 1, 1915, it was not until May 4 of the past year that that union was made a rigid one at the center. Until then the bridge was a three hinged arch, one hinge at each foot and the third at the middle. With the riveting of the central joint the arch became a two hinged span. To make this change it was necessary to wait for certain conditions of the weather and the temperature, so sensitive was that gigantic mass of steel to the influence of heat and cold. With conditions right, a sliding connection at the top of the arch was chained into a riveted joint, and with that done the stiffness of the arch was considerably augmented and made just so much more capable of withstanding the stresses of moving trainloads.

The work of building this mammoth arch began early in 1915, the actual preparation of the steel work having been started months before at the mills. Since then the erection has gone on with the precision of clockwork, and enormous as the task has been it is reaching its completion within schedule time.

Over on the Ward's Island shore, however, the engineers discovered after reaching the underlying ledge that the rock was crossed by a great diagonal fissure. This necessitated the sinking of twenty-one pneumatic caissons, the deepest of them going down 120 feet below the ground surface. This task alone took seven months of continuous and laborious work, and although the "sand hogs" toiled under a very heavy air pressure there was not a single fatal case of caisson disease because of the skilful supervision and the prompt recourse to the hospital lock whenever any of the men showed symptoms of "bends."

On the western approach the New York Connecting Railway runs from the tracks of the New York, New Haven and Hartford line at 125th street and swings to the south and east, passing over the Bronx Kill, Randall's Island and Little Hell Gate, and thence upon a steadily rising viaduct joins the Hell Gate arch on Ward's Island. At that point the tracks reach an elevation of 135 feet.

Crossing Hell Gate, the railroad continues its way still upon a towering viaduct a half mile long and 135 feet high, and then gradually descends to grade after swinging around to the south and west in order to arrive at the Sunnyside yard of the Pennsylvania Railroad, Long Island City. At that point the tracks run directly into the East River tubes of the system. The trains will all be drawn by electric locomotives and every part of the line, including the stretch over Hell Gate, is stone ballasted in order to give rigidity to the roadbed and to reduce noise. At fairly frequent intervals along the route there are sidings by which passengers can reach the ground in case of accident or during a prolonged halting of traffic.

Ordinarily the bridge over Little Hell Gate would be considered an engineering feature well worthy of detailed description, but in the present instance it is overshadowed by its neighbor spanning the East River. The Little Hell Gate bridge has a total length of 1,154 feet, and is composed of four inverted bowstring truss spans. To the uninitiated these trusses viewed from a distance are slim looking fabrications and yet they are really massive, because they are made up of linked eye bars sixteen inches wide and more than two inches in thickness. Not only that, but the juncture of contiguous sections is effected by means of pins sixteen inches in diameter.

The third bridge in the system is that over the Bronx Kill. As this waterway will be dredged in time so as to permit navigation by large vessels, it was necessary to provide a lift bridge. It is of the bascule type and consists of two spans each 175 feet long. In sinking the foundations for the piers of this structure uncertain ground was struck, and the engineers finally had to go down well over a hundred feet before reaching solid rock.

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Reviving the Handicrafts of Our Great-Grandmothers

JUST a little thing I picked up in America. Hand made, of course. The peasants in the Southern States make them in their own homes."

There's something about that statement that sounds wrong, in spite of the fact that it is very familiar. You've heard it often, only instead of America it was France or Germany or Holland or Belgium or Spain.

Americans have been picking up little things made by hand all over Europe for the last hundred years. Some time in connection with the foreign made art work they can show a hand woven bodyspread or a bright colored sampler made by a Colonial ancestress, but these are heirlooms. It is often taken for granted that nothing worth while is made in America to-day by hand because people are too busy, too commercial. It sounds inconsistent in view of the fact that Americans pay high prices for the handicraft of Europe.

The arts of our great-grandmothers are forgotten to a large extent and whatever knowledge of handicraft immigrants bring with them from Europe is soon lost in the mechanical roar and hurry of American factories.

At least this was true until a few months ago when three young professional women appeared on the scene, entering business and bringing art with them, or entering art and bringing business with them. It isn't quite clear which, for with them art and business are as closely allied as they are widely separated as a rule.

These three women are Mrs. Rose Watson, who up to a year ago was expressing her art through the medium of some new ideas of child culture in a school of her own; Miss Eleanor Flowers, who was on the stage, and Miss Earnestine Evans, a journalist. They have combined forces and have started an all-American revival of handicrafts so long buried under modern machinery that no one without the ideas of these three enthusiastic, artistic business women would ever have dreamed it possible that they could be brought back to life.

They have searched through the South and have found women living in isolated farmhouses who still remember the art of hand made patchwork quilts and hand woven bedspreads. Faded away in the attics of these old farmhouses were looms covered with dust and cobwebs, and some of these have been brought down from their retirement and put back to use by women who are taking joy in work they had long given up as having no place in modern life.

A year ago there was a factory on the Palisades where hand woven silks were made. The three artistic business women searched until they found the discarded hand looms; they bought them and set them working again and manned them with old workmen whose fingers have not forgotten the skill taught by their masters in France and Belgium. The workmen are all old men, and it took a long search to find them harnessed to soulless, automatic machines in factories all over America. But at last enough were found to begin, and these old men will in turn take apprentices so that their art may not die and the Flambeau Weavers of

the Palisades may continue long after the first workers have gone.

Here are woven silks of beautiful colors, dyed by hand with vegetable dyes, for curtains, draperies, scarfs or "Paris" frocks, the "sort of thing you can't get in America," woven to last through generations and dyed with colors that never fade.

The Flambeau Weavers have opened a gallery in this city for the display not only of their own products but also of the work of every other American artist skilled in handicraft. Here are shown patchwork quilts and knitted bedspreads from Georgia and South Carolina, gorgeous blue and yellow dragonfly lustre pottery made by a woman in New York, hand made furniture, the wood polished and stained until it looks like brass, and dozens of other varieties of hand work resurrected from the almost forgotten secrets of the past or produced by the original brain of some modern artist who has never before had an opportunity to bring his work before the public.

The Flambeau gallery is designed as a clearing house for hand made American art work. Here any artist whose work shows merit can exhibit without charge and seek a market for the products of his brain and hands among people who have real art appreciation regardless of whether the worker comes from Sevens or Hoboken.

Here one can find hooked rug chair seats in curious designs, hand woven tapestries, braided mats of bright colors made by the blind workers at the Lighthouse, Japanese batik work on silk for sofa pillows or hangings or even dress designs. There are picture frames of rosewood inlaid with ivory

made in Mexico and Mexican altar cloths showing a weird combination of Indian legend and Bible history in their composition; hand made laces and hand wrought jewelry—every kind of art, no matter what form of expression the artist chooses to use.

"We believe that we are doing a big work for American art," explained Miss Flowers. "That there is a demand for this sort of thing is shown by the number of people who go abroad to get it. It is a disgrace that America has gained the reputation of having nothing to offer to the world of art."

"As a matter of fact we really have more to offer than any other country in the world, for our population is made up of people from every country in the world and they have brought with them the art of their own people. The only trouble is that American artists have never been encouraged."

"Weavers have come to us from other lands and have found that their skill was of no value in a country where the machine rules everything, so they went into factories and their children have grown up without knowledge of the handicraft of their fathers, until now the art of hand weaving is almost lost in America. We had to search far and wide before we found a few old men to put to work at our looms on the Palisades."

"It is the same with new arts. The artist designs something original and sells a few copies just as a novelty and there the matter ends. Neither the world of art nor the artist is any the richer for his labor."

"The Flambeau weavers are going to change this condition. We are making it possible for every artist to

bring his work before the public. We give him an audience with the world by exhibiting his work free of charge where it can stand or fall on its own merits. Of course if the work does sell we get a commission. We are not working altogether on the principle of art for art's sake."

"Men have always considered art and business incompatible, but with the entrance of women into the world of business a change is sure to come. We can put art into business and business into art without detracting from the merit of the one or the profit of the other."

"Just now while the rest of the world is at war is America's chance to prove that she is not all sordid commerce, that her enormous prosperity has brought her something better than a keener appetite for more gold and that worthy artists need not starve and die unrecognized even in commercial America."

It was a long speech, and the enthusiasm with which Miss Flowers delivered it made me feel like a 10,000 so they went into factories and their children have grown up without knowledge of the handicraft of their fathers, until now the art of hand weaving is almost lost in America. We had to search far and wide before we found a few old men to put to work at our looms on the Palisades."

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